TEACHING AND LEARNING MATHEMATICS HUMANISTICALLY

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Usually, a professor of mathematics shows a few examples, and assigns students some sk exercises for a drill. As a result, many students come to a view that mathematics is useless in rea boring, and incomprehensible. Teaching mathematics humanistically demands creativity of both professor and a student. This theme emphasizes the meaning of emotional climate for lea mathematics. There are lots of promising ideas: historical background showing mathematics as a hu discipline, interesting problems and open-ended questions, supreme beauty in mathematics, worki groups and teaching by projects, using of a computer algebra systems, mathematics applicati business, economics, art, and architecture. Which way should we go?

Historical background

How can we design mathematical courses that encourage students for excitement about m connections in mathematics? One approach is to introduce a discussion via topics familiar to stu and to expand the dialogue with historical references and activities that lead to a discovery o directions or themes.

An example of a surprising fact in mathematics can be found in connection with r polyhedrons. Pythagoras in the 500s BC knew that there can exist only five types of regular polyh with respectively 4 (tetrahedron), 6 (cube), 8 (octahedron), 12 (dodecahedron) and 20 (icosah polygonal lateral faces. The regular polyhedrons were associated with the four elements in philosophy: *fire (tetrahedron), air (octahedron), earth (cube), water (icosahedron). The dodecahedr* associated with an image of the universe itself.

It is not difficult to speculate exist upon possibility of existence of more than five polyhedrons. No kinds of experiments are sufficient to get a final answer to this question. It can settled by a mathematical proof. A proof can be based on the theorem that the alternating sum of of vertices, edges and polygonal faces in the surface of a convex polyhedron equals 2, stated by E

PROBLEM SOLVING AND GROUP PROJECTS

First of all, a problem is a non-routine task which is being encountered by the student *very first time and, therefore, there is no obvious algorithm for the student to use. There are two* mathematical problems: problems to find the unknowns and problems to prove which co conjecture.

After this, a problem is a task which has certain open questions that challenge the emotionally and intellectually. A problem is relative to students involved, i.e. what is a problem student may be an exercise for another. For example, the task to solve the equation $x^8 - 1 = 0$ may be a problem for a schooler but not for a student.

What motivates professors or students to create problems and why some kinds of *problems are more appealing to one that to others? So we begin to participate in a dialogue th* people to reflect on what they value and how they think. Then many other questions (some philosophical) are considered, such as: Am I interesting in pursuing this problem? Do I unders problem? What would it take for me to understand it better? Why am I being presented with this at this time? Are there others who have a different interest in this problem than I? Why?

As an example of a good posed problem and a good problem solving we consider the p finding the sum of the natural numbers from 1 to 100. As the myths goes this is a problem th

In less than a minute by noticing that the first and the last numbers added to 101, the second [illegible] penultimate numbers added to 101, and so on. After this, it would not be difficult to generalise the [illegible] for finding the sum of the first n natural numbers.

Even when a problem and a solution are both presented, the pair "problem-solution" would [illegible] force to generate questions that have a humanistic focus for the solution itself. We could analyse a [illegible] deal of information about the time and place of its origin. It is also possible to investigate the problem [illegible] such a way that each of us can use any resources we have at our disposal and imagine what might h[illegible] been the circumstances that gave rise to the idea, for example, with regard to Goldbach's [illegible] conjecture, Fermat's last theorem or Euclid's proof of an infinite number of primes.

Group projects for students can be centred on the symmetry, the Pythagoreans' work [illegible] figurate numbers [2]. We could use computer algebra systems, for example, Maple to avoid [illegible] calculus and to have more time for reflection. The system Maple includes facilities for interactive alge[illegible] calculus, discrete mathematics, graphics, numerical computation and many other areas of mathema[illegible] [3].

Students quickly become intrigued with discovering patterns, tessellations, three dimensio[illegible] geometric interpretations of algebraic equations [1], obtaining sequences, and finding sums based [illegible] figurate numbers. We could encourage students to act like mathematicians and demonstrat[illegible] mathematician's need to invent proofs as a result of creative impulses and intellectual challen[illegible] Students learn how to prove enables mathematicians to comprehend the structure of their discipl[illegible] reveals connections between topics, and empowers mathematicians to unify mathematical theories [illegible] lead to new discoveries.

SUPREME BEAUTY IN MATHEMATICS

An interesting case for mathematics as an art is a possibility of regarding at least some of [illegible] products as objects of aesthetic enjoyment.

Mathematics is a language, that uses carefully defined symbols and notions, a science and art, characterized by order and internal consistency, harmony and beauty. Professors working together [illegible] improve mathematical education must explore connections between mathematics and art, in particu[illegible] the idea of symmetry, in order to enlarge and enliven courses ranging from elementary mathematics [illegible] abstract mathematics. Mathematics should include experiences that help students to shift their think[illegible] about mathematics and define mathematics as a study of patterns and relationships, a science and art [4].

As an example, what are tessellations? It is a periodic drawing division, a rhythmic theme or [illegible] plane, an arrangement of regular or irregular polygons or some repeating figures that completely cov[illegible] the plane without overlapping or leaving gaps. Why are we interested in tessellations? They look n[illegible] They teach us mathematics!

The mathematics can explain works of art. Beautiful patterns in Islamic art inspire discussions [illegible] geometry and symmetry. In relation to the works of the Dutch artist Escher, it is possible to discu[illegible] mathematics at a relatively advanced level, such as the Poincaré disc model of the hyperbolic plane.

A concept of elegance in mathematics might include the following aspects: an elegant solution [illegible] relatively easy to understand; an elegant solution is brief; it involves an unexpected creation. Where mi[illegible] we look for elegance in mathematics? Usually elegance in mathematics associated with proofs [illegible] statements of theorems or conjectures. As a rule, the elegant proof or a statement connects up concep[illegible] that at a first glance could not look more unrelated.

Mathematics application

We live in a world that has been decisively shaped by the applications of mathemati[illegible] Mathematics will advance in response to practical challenges and its internal momentum of mathemati[illegible] curiosity. New connections are discovered between apparently different fields: mathematics and ar[illegible] mathematics and architecture, mathematics and physics, mathematics and biology.

It can be fruitful to incorporate examples from the arts, architecture or nature in the teaching [illegible] mathematics. For example, such mathematical notions as golden section, perspective and tessellation [illegible] used in art. We can apply knowledge in mathematica (golden section, Fibonacci numbers [illegible] tessellation) to architecture for creation of beautiful buildings. Some wonderful objects of nature [illegible] shells, petals on flowers, pine cones, leaf arrangements etc) are related to the Fibonacci numbers.

In teaching mathematics it is important to get the abstract structures linked to [illegible] manifestations of mathematical relations in outer world.

The present world goes through the process of globalization. Nowadays practical application [illegible] mathematics often goes immediately after scientific discoveries. All these new developments [illegible] necessarily of a renewed thinking on ethical criteria for mathematical activities and teaching mathe[illegible] [illegible] is moreover encouraged by the increasing disciplinary specialization. Without a doubt, mathe[illegible] education could ethically apply existing versions of mathematics. In addition, there is a need to [illegible] with more interactive process of communication between scientists (not only mathematicians) [illegible] professors and students on connections between mathematical discoveries and their ethical application[illegible]

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